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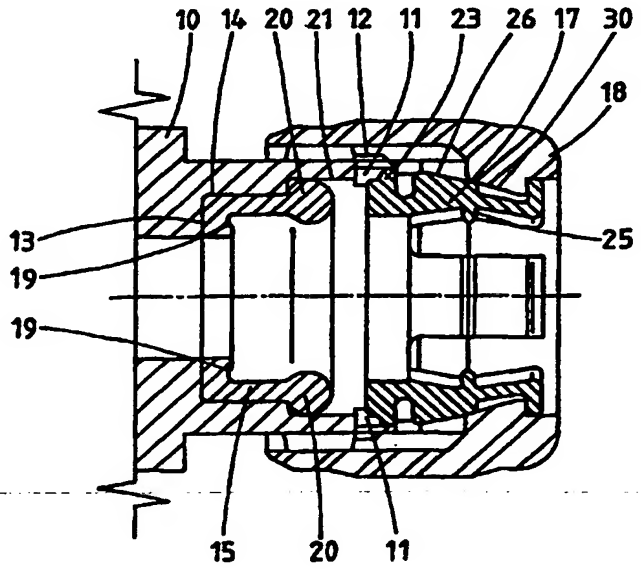

(57) Abstract

The invention provides a tube connector which comprises a tubular body (10) to receive the end of a length of tube and having an internal annulus (14) to abut against the end of the tube, a collet (17) capable of gripping the external surface of the tube near to its end, and a securing cap (18) attachable to the body portion (10) to hold the collet (17) against the external surface of the tube, characterised in that the external surface of the collet (17) and the internal surfaces of one or both of the body portion (10) and cap (18) have co-operating shapes such that as the cap is moved into its securing position, the collet first grips the external surface of the tube and then moves with the so-gripped tube towards the internal annulus of the body portion and thereby brings the tube end into firm abutment therewith.

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IMPROVEMENTS IN TUBE CONNECTORS

This invention relates to a connector for the end of a tubular pipe. Connectors according to the invention are particularly well suited for use with plastic tubing employed for conveying beverages and the invention is primarily described herein with reference to that application.

Traditional tube-end connectors, for example for the ends of copper or plastic conduits for water supply and drainage, commonly include an assembly of an internally threaded cap, a deformable compression ring and an externally threaded tubular fitting to receive the tube end. In the assembled connector the compression ring is deformed and creates a liquid-tight seal between the cap, fitting and tube surface. Such connectors are satisfactory for most domestic duties but tend not to be suitable for the semi-rigid plastic tubing commonly used for beverages. Connectors for such beverage tubing are generally push-in

fittings, typically comprising a hollow body to receive the tube end, which body is shaped to form a seat for an O-ring seal surrounding an inserted tube, thereby creating a seal between the body and tube, and further has a body end portion surrounding a collet which in turn surrounds the tube, such collet having resilient legs with shaped tube-engaging surface portions which co-operate with the body end portion to provide camming surfaces which resist withdrawal of the collet and/or the tube. An alternative version of connector suitable for beverage tubing comprises a collet in the form known as a grab ring, for example of stainless steel, to grip the tube and has a sleeve which can be pushed against the ring to release the tube.

In order to provide a tube connector with both a liquid-tight seal and a strong grip on the tube it has been proposed to employ internal projections on the tube-engaging portions of the collet so as to bite into the external surface of the tube end and thereby hold it firmly in place. A disadvantage with such projections is that when the tube is intentionally withdrawn from the connector, the projections tend to remain embedded in the tube surface so that the tube is scored as it is removed, that is to say longitudinal grooves are formed along the outer surface of the length of the tube end that had been retained in the connector. Such scoring makes for difficulties in re-using the tube. Not only is the tube damaged by the scoring, but the longitudinal grooves make it very difficult to recreate an adequate seal.

Another disadvantage of prior connectors for semi-rigid plastic tubing has been that a side load applied to the tube adjacent to the connector tends to distort the cross-sectional shape of the tube end within the connector body and thus to break or open the seal, thereby creating a leak path from the connector.

A further problem with connectors for tubes carrying beverages is that deposits of undesirable materials such as bacteria may build up within the connector to an extent sufficient to taint the flavour of the beverage or to create a hygiene problem. This problem is most likely to arise with those types of beer and milk which contain live microorganisms.

It is a principal object of this invention to provide a tube connector which offers improvements in the provision of a firm and hygienic leak-tight fitting for a tube end.

According to this invention there is provided a tube connector which comprises a tubular body portion to receive the end of a length of tube and having an internal annulus to abut against the end of the tube, a collet capable of gripping the external surface of the tube near to its end, and a securing cap attachable to the body portion to hold the collet against the external surface of the tube, characterised in that the external surface of the collet and the internal surfaces of one or both of the body portion and cap have co-operating shapes such that as the cap is moved into its securing position, the collet first grips the external surface of the tube and then moves with

the so-gripped tube towards the internal annulus of the body portion and thereby brings the tube end into firm abutment therewith.

The invention offers the advantage that by enabling a positive thrust of the tube end into the body and retaining it in that position, a firm seal can be provided between the end as such and the body. Any gaps between the tube end and the body, in which build up of undesired materials could occur, are reduced or eliminated.

To assist in ensuring a closely matching abutment between the tube end and the body, it is preferred to employ the connector of the invention with tubing having a smooth end surface which is at right angles to the tube axis. If the tube end to be connected is rough or angled, then it is preferably cut to the preferred configuration prior to use. Such close-matching abutment between the tube end and connector body is especially important in avoiding any gaps in which undesired materials can collect.

The connector of the invention preferably includes a resilient sealing member between the tube and body portion providing at least an end face seal. Suitable materials for this member include rubber and resilient plastics.

In all versions of the invention the internal diameters of the tube, the abutment within the body portion and any abutting sealing ring within the body portion are desirably all the same. This ensures a clear, unrestricted fluid flow path through the tube and connector and further assists in preventing any undesirable material build up.

In one convenient embodiment of the invention the resilient sealing member comprises a tubular sleeve to fit around the tube end and having at one end of the sleeve an annular portion integral with the sleeve but having a smaller internal diameter than the sleeve, so as to form an abutting seal between the tube end and the internal annulus of the body portion, and having at the other end of the sleeve an annular portion also integral with the sleeve but which contacts the periphery of the tube so as to form additionally an external seal around the tube adjacent to the end and within the body portion.

In its unstressed configuration, i.e. when it is not being urged by the relative positions of the cap and body into contact with the tube, the collet preferably has an internal diameter greater than the external diameter of the tube. This has the advantage that the tube end can be inserted prior to securing the connector or withdrawn after it is released by the connector without touching the collet or any internal ribs or teeth therein and thus avoids the possibility of longitudinal scoring of the tube as it is inserted or withdrawn.

The co-operating shapes of the body, collet and cap which effect the gripping and movement action upon the tube within the connector are conveniently provided by one or more tapering portions on one or more of the surfaces of the body, collet and cap which come into engagement as the cap is moved into the securing position. Preferably the external surface of the collet is tapered at one or both of

its ends (becoming narrower in external diameter towards the respective end) to engage with corresponding abutments or tapers on the cap and/or the body portion. If only one taper is present on the collet this is preferably at the end abutting the cape (the "trailing" end). The abutment between the cap and collet at this trailing end not only thrusts the collet and gripped tube forward as the cap is moved into the securing position, but also serves to increase the trip of the collet on the tube end if the tube is pulled in the direction away from the connector. The increased grip resists any inadvertent removal of the tube end from the connector.

Especially when the collet includes a taper at the end abutting the body portion (the "leading" end), the body portion preferably has a corresponding shape comprising two tapered sections with intermediate non-tapered "lands" sections. This internal body configuration of alternate tapers and lands has the effect that as the collet is moved further into the body by the action of the cap, the first taper serves to bring the collet into the required gripping contact with the tube surface, and causes any internal projections to bite lightly into the tube surface. Further inward movement of the cap effects the required movement of the collet and gripped tube forward through the respective land section, initially to touch and then to press upon the internal annulus or any seal abutting therewith. As the cap is moved further, the second body taper brings the collet into a firm "locked-up" clamping attachment with the

tube surface, thereby resisting any forces which might tend to pull the tube end away from an end seal or out of the connector.

Preferably the collet is tapered at both ends. In this configuration gripping of the tube end occurs at both the leading and trailing end of the collet such that in the final locked-up position the tube end is firmly held at both the leading and trailing ends of the collet. In this locked-up position, the tube is not only extremely difficult to remove from the connector but is also resistant to distortion, for example from a sideways-applied force, which would otherwise tend to break the seal and permit leakage.

The cap and body portion preferably have mutually engaging threads, the action of moving the connector into and out of its clamping position being effected by screwing the cap respectively towards and away from the body. The most convenient arrangement is generally for the threads to be internal on the cap and external on the body. The cap preferably includes longitudinal external ribs to assist easy turning of the cap by hand. A threaded arrangement assists in applying a strong clamping force to hold the respective parts in close abutment with each other.

One or both of the body portion and cap preferably include further projections, for example ribs, rims or stops, which serve to retain the component parts within the connector body.

An advantage of the connectors according to the

invention, provided that the material from which the collet is made is sufficiently resilient, is that when the cap is moved back from the locking and gripping positions, the resilient material of the collet moves it away from the tube surface, thereby allowing removal of the tube end without any risk of scoring and thus significantly increasing the number of times a given tube can be employed. However, if materials of lesser resilience are used, a suitable release mechanism (e.g. a "top hat" release mechanism) is preferably employed to prevent scoring of the tube surface as the tube end is removed.

The dimensions of the connectors according to the invention are primarily dictated by the external and internal diameters of the tubes they are to fit and thus a range of sizes or connectors according to the invention can be provided to match the standard range of tube sizes. If it is desired to connect more than one tube lengths together then two connectors according to the invention can be employed in "back-to-back" abutment.

The invention offers the further advantage that the body portion of the connector can be integral with a unit such as a dispensing tap, thereby giving a direct "clean-in-place" attachment of the tube to the point of use and assisting in ensuring long-term hygienic conditions at the point of use.

The invention is further described below by way of example with reference to a version of connector according to the invention as illustrated in the accompanying

drawings, but it is to be understood that the invention is not limited to this example.

In the accompanying drawings:

Figure 1 is a section through a pipe connector embodying the present invention;

Figure 2 shows the connector with the pipe inserted before tightening up the connector;

Figure 3 shows the next stage in effecting a seal between the pipe and the inner end of the connector;

Figure 4 shows the stage reached when the connector is fully assembled and tightened up;

Figure 5 is a section through a seal forming part of the connector;

Figure 6 is a plan view of the seal shown in Figure 5;

Figure 7 is a section through a collet forming part of the connector;

Figure 8 is a plan view of the collet shown in Figure 7;

Figure 9 is a section through a screw cap forming part of the connector;

Figure 10 is a plan view of the cap shown in Figure 9;

Figure 11 is a section through a collet incorporating a metal grab ring; and

Figure 12 is a section through a collet incorporating a grip release mechanism.

Referring initially to Figures 1 to 4, the pipe connector comprises a body 10, which may for instance be part of a coupling for joining one tube to another, or may

be part of a connector for joining a tube to apparatus such as a tap or a barrel or a pump.

The body 10 has two diametrically opposed slots 11, an external thread 12 and a seal seating surface 13 at the base of a reduced diameter portion 14 adapted to receive a seal 15 (also shown in Figures 5 and 6), the seal 15 in turn being adapted to receive the pipe 16. The remaining parts of the connector comprise a collet 17, also shown in Figures 7 and 8, and a screw cap 18, also shown in Figures 9 and 10.

The seal 15 is a combined unitary face seal and ring seal. The face seal 19 is arranged to abut the seating surface 13 and the ring seal 20 contacts the inner wall 21 of the body 10.

The collet 17 (see Figures 7 and 8 in particular) has an end ring 22 with retaining features 23 adapted to engage loosely the slots 11 of the body 10. It has four legs 24 each of which has a projection 25 adapted to engage the tube surface and to grip the tube. Each leg also has an outwardly extending ramp 26.

The screw cap 18 has an internal thread 27 adapted to engage the external thread 12 on the body 10, and also has an external serrated grip 28.

In use, as shown in Figures 1 to 4, the seal 15 is inserted into the body as shown in Figure 1. The collet 17 is then inserted so that the retention features 23 loosely engage the slots 11. The collet 17 is thus held captive in the body 10.

The cap 18 may then be slid onto a tube and the tube inserted into the assembly as shown in Figure 2. As the cap 18 is tightened, each ramp front edge 29 (see Figure 3) engages the body which causes the legs of the collet to move inwardly thus enabling the projections 25 to contact and penetrate slightly the wall of the tube to grip it. Further movement of the cap, as it is screwed on, causes engagement between a wedging surface 30 on the cap and the ramp 26 (see Figure 4), and this causes an increasing grip on the pipe and movement of the pipe to the left, as seen in Figure 4, to give a firm end seal. The pipe must be cut square to give a good end seal and if it is cut square, the ring seal has only a secondary function. If it is not cut square, the ring seal provides a back-up seal for any possible leakage.

The parts of this connector may all be made of plastics, for lightness, cheapness and for hygienic reasons. Where appropriate, however, metal may also be used in certain applications. In particular the projection 25 may be formed as a stainless steel insert with sharp edges and the whole collet can also be of stainless steel, for example. The cap, when undone, reaches a resistance point and therefore cannot vibrate off. The collet is also loosely held in position so that it cannot fall out. Thus the connector can be undone and the pipe released without dismantling the whole connector and none of the parts will shake free if the connector is moved about.

Figure 11 illustrates a collet 31 which corresponds

generally in shape to the collet illustrated in Figure 7, except that the gripping projections 33 form part of a separate metal grab ring 32 which is located in an annular recess 34 in the inner surface of the collet 31.

The grab ring 32 is conveniently formed from stainless steel and can be fabricated by cutting slots along one side of a rectangular strip of stainless steel, rolling the slotted strip into an annular shape, and crimping the slotted edge of the strip to form the radially inward projections or teeth 33. An advantage of the two-part collet illustrated in Figure 11 is its relative ease and cheapness of manufacture. As an alternative to the cylindrical grab ring, the radially inward projections or teeth 33 could be formed by simply insert moulding an annular gripping ring into the body of the collet.

As indicated above, it is preferred that the collet is made of a material which is sufficiently resilient that when the cap is moved back from the locking and gripping position, the resilient material of the collet moves it away from the tube surface to allow removal of the tube end without risk of scoring. However, if the collet is not made of a sufficiently resilient material, a release mechanism may be employed to release the gripping effect of the collet on the tube end. Such a mechanism is illustrated in Figure 12.

As shown in Figure 12, the collet 35 corresponds generally in shape to the collets of Figures 7 and 11. However, as with the collet of Figure 11, the collet of

Figure 12 is of a two-part construction with a grab ring 36 being located in an annular recess 37 in the inner wall of the collet. Grab ring 36 has radially inturned ends 38 which act to grip the tube end when the assembly is tightened.

In this embodiment, a gripping release member 39 is inserted into the end of the collet 35. Gripping release member 39 is of generally cylindrical form and has a radially outwardly extending flange 40 at one end. When it is desired to release the grip of the collet on the tube end, the flange 40 is pushed so as to urge the cylindrical body of the gripping release member into the collet such that its inner end 41 cams against the inner surface 42 of the inturned end 38 thereby forcing it radially outwardly and away from the tube end.

The invention has been illustrated by reference to the particular embodiments shown in the accompanying drawings, but it will readily be appreciated that numerous modifications and alterations may be made to the embodiments shown in the drawings without departing from the principles underlying the invention. All such modifications and alterations are intended to be embraced by this Application.

CLAIMS

1. A tube connector which comprises a tubular body portion to receive the end of a length of tube and having an internal annulus to abut against the end of the tube, a collet capable of gripping the external surface of the tube near to its end, and a securing cap attachable to the body portion to hold the collet against the external surface of the tube, characterised in that the external surface of the collet and the internal surfaces of one or both of the body portion and cap have co-operating shapes such that as the cap is moved into its securing position, the collet first grips the external surface of the tube and then moves with the so-gripped tube towards the internal annulus of the body portion and thereby brings the tube end into firm abutment therewith.

2. A tube connector according to Claim 1 which includes a resilient sealing member which in use is disposed between the tube and body portion to provide at least an end face seal.

3. A tube connector according to Claim 2 which has resilient sealing means for providing a seal against the outer diameter of the tube end.

4. A tube connector according to Claim 3 wherein the resilient sealing member for providing the end face seal, and the resilient sealing means for providing a seal against the outer diameter of the tube end are formed integrally with one another.

5. A tube connector according to Claim 4 wherein the resilient sealing member comprises a tubular sleeve to fit around the tube end and having at one end of the sleeve an annular portion integral with the sleeve but having a smaller internal diameter than the sleeve, so as to form an abutting seal between the tube end and the internal annulus of the body portion, and having at the other end of the sleeve an annular portion also integral with the sleeve but which contacts the periphery of the tube so as to form additionally an external seal around the tube adjacent to the end and within the body portion.

6. A tube connector according to any one of the preceding Claims wherein, in its unstressed configuration, the collet has an internal diameter greater than the external diameter of the tube.

7. A tube connector according to any one of the preceding Claims wherein the co-operating shapes of the body portion, collet and cap which effect the gripping and movement action upon the tube within the connector are

provided by one or more tapering portions on one or more of the surfaces of the body, collet and cap which come into engagement as the cap is moved into its securing position.

8. A tube connector according to Claim 7 wherein the external surface of the collet is tapered at one or both of its ends, becoming narrower in external diameter towards the respective end, to engage with corresponding abutments or tapers on the cap and/or body portion.

9. A tube connector according to Claim 8 wherein the collet includes a taper at the end abutting the body portion, and the body portion has a corresponding shape comprising two tapered sections with intermediate non-tapered lands sections.

10. A tube connector according to Claim 9 wherein the collet is tapered at both ends.

11. A tube connector according to any one of the preceding Claims wherein the securing cap is attachable to the body portion by means of mutually engaging threads on the securing cap and body portion.

12. A tube connector according to any one of the preceding Claims wherein the collet has integrally formed

gripping means for gripping the external surface of the tube.

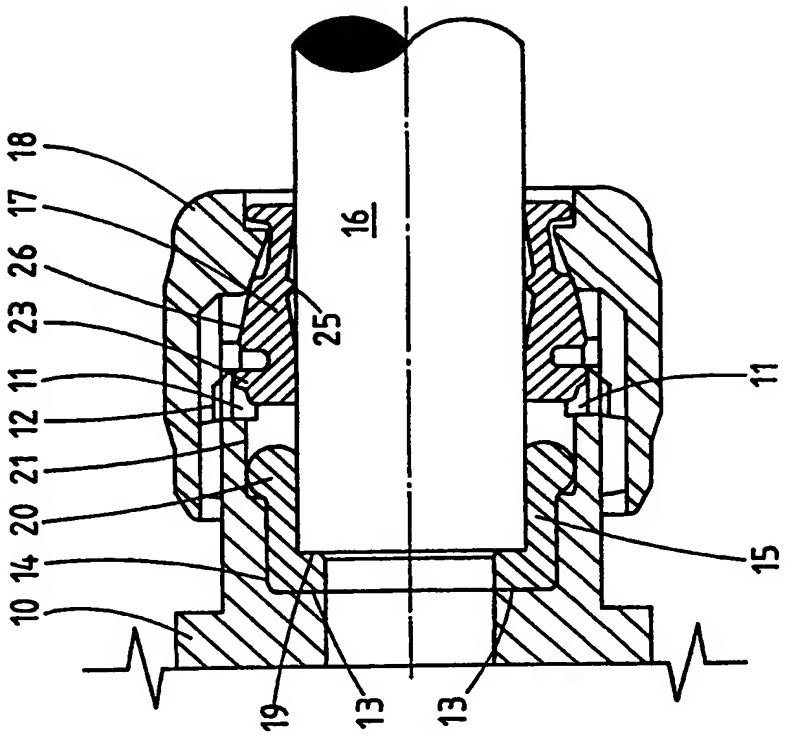

FIG.2

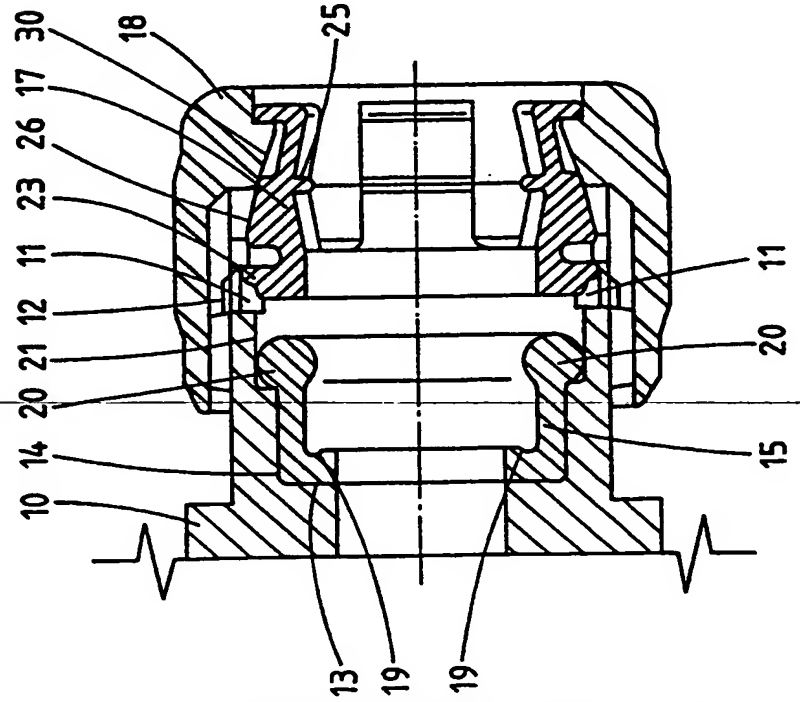

FIG.1

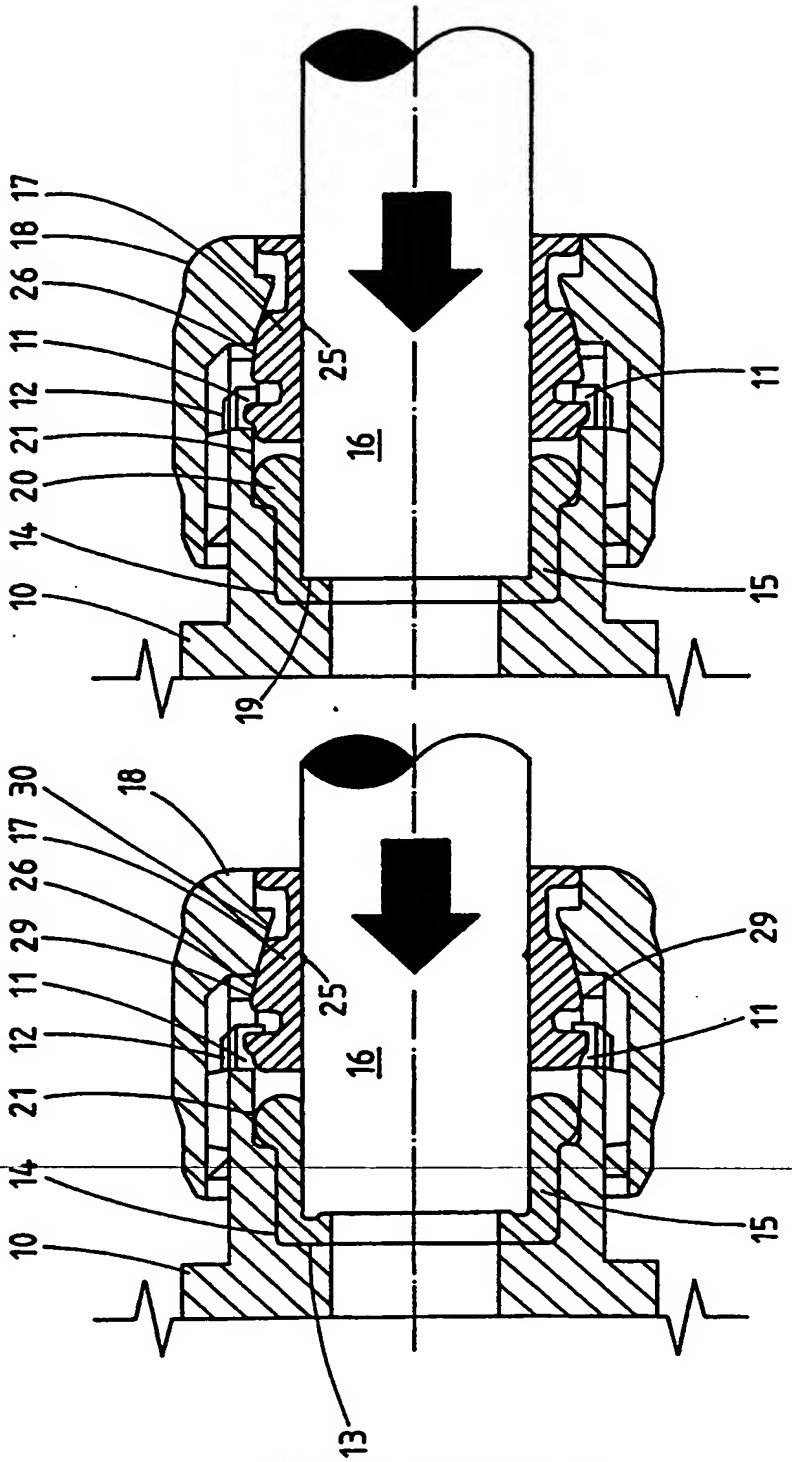

FIG.4

FIG.3

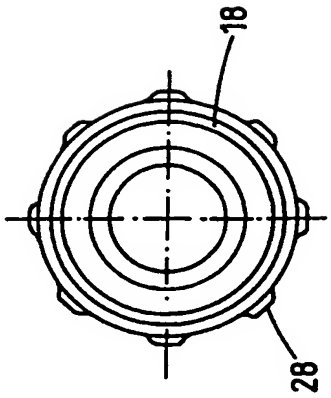

FIG.10

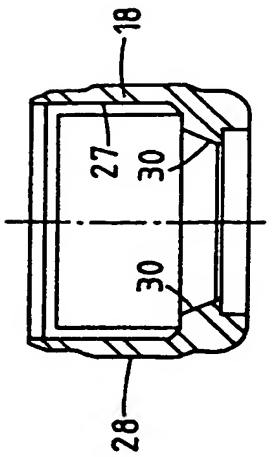

FIG.9

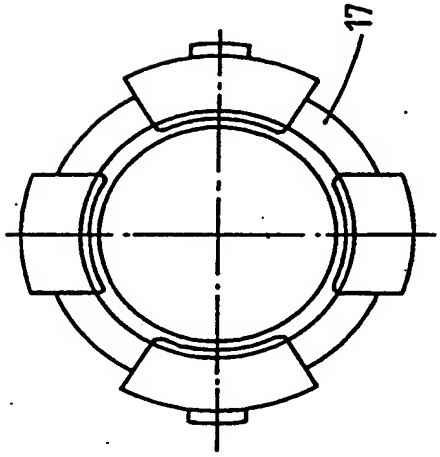

FIG.8

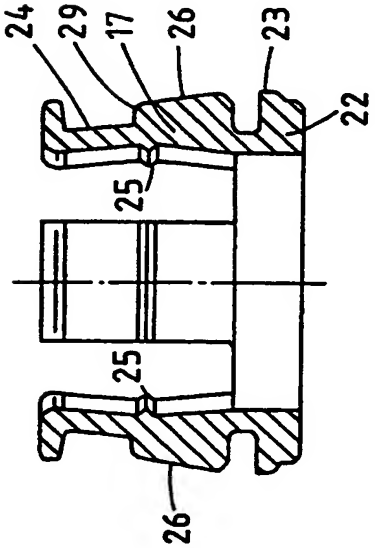

FIG.7

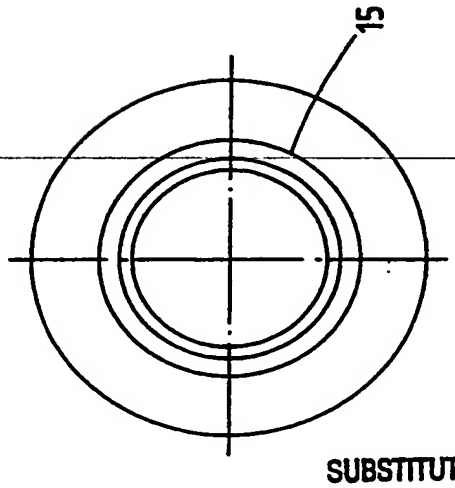

FIG.6

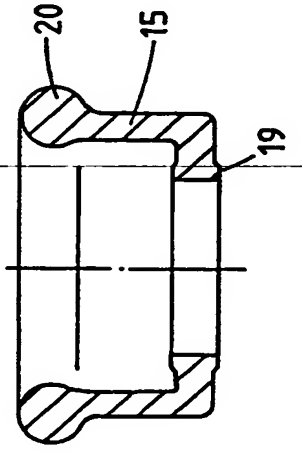

FIG.5

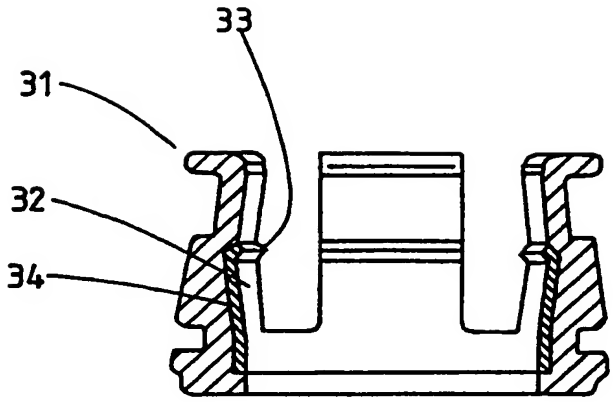

FIG.11

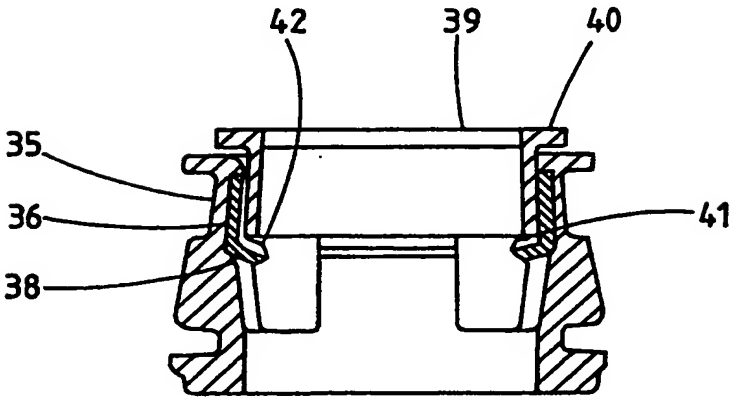

FIG.12

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/00885

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L19/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,3 485 517 (E. E. HOWE) 23 December 1969 see figures 1-6 ---	1-12
X	US,A,3 434 744 (M. P. YOKE ET AL.) 25 March 1969 see figures 1,2 ---	1-6
A		7,8,11
X	US,A,2 579 529 (G. V. WOODLING) 25 December 1951 see figures 1-5 ---	1,6-8, 11,12
X	FR,A,1 288 520 (A. NIMESKERN) 12 February 1962 see figures 1-3 -----	1,6-12

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Date of the actual completion of the international search	Date of mailing of the international search report
13 July 1995	25. 07. 95

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3485517	23-12-69	NONE	
US-A-3434744	25-03-69	NONE	
US-A-2579529	25-12-51	NONE	
FR-A-1288520	08-08-62	NONE	